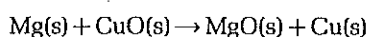


9.5 Competition for oxygen

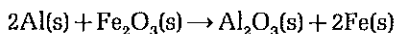
Metals high in the reactivity series combine with oxygen present in oxides of metals lower in the series. More reactive metals reduce the oxides of less reactive metals. This is known as oxygen competition (two metals compete for oxygen) and the more reactive metal wins.

For example, when magnesium is heated with copper(II) oxide a very fast, almost explosive, reaction occurs.



Magnesium is more reactive than copper and so 'wins' the oxygen from the copper. When magnesium oxide and copper are mixed and heated no reaction occurs. This is because the copper is less reactive than magnesium.

Aluminium powder reacts with iron(III) oxide producing aluminium oxide, molten iron and a large amount of heat.



This is known as the **Thermit reaction**. It occurs because aluminium is more reactive than iron.

Aim

To investigate the displacement of metals from metal oxides.

Apparatus and materials

Bunsen burner and mat	Copper powder
Tongs	Lead powder
Spatula	Copper(II) oxide
Ceramic paper	Lead(II) oxide
Iron filings	Iron(III) oxide

Procedure

- 1 Mix well one spatula measure of iron filings with one spatula measure of copper(II) oxide on a piece of ceramic paper.
- 2 Use tongs to hold the ceramic paper in a roaring Bunsen flame.
- 3 Heat the mixture for 5–10 minutes.
- 4 Tip the mixture onto a mat and inspect it for signs of copper. If no copper is visible heat for a further 5–10 minutes.
- 5 Repeat steps 1–4 for the other combinations of metals and metal oxides shown in the following table. Carefully inspect the residue in each case for any chemical change.

Results

Copy and complete the following table:

	iron(III) oxide	copper(II) oxide	lead(II) oxide
iron			
copper			
lead			

In the 'oxygen competition' arrange the metals in order of their ability to take oxygen away from each other.

- 1 (most competitive)
- 2
- 3 (least competitive)

Extra work

- Use manganese(IV) oxide and tin(II) oxide in the experiment. Place manganese and tin in the order of reactivity of metals.

Questions

- 1 a) Why is the formation of lead easier to see than that of iron?
b) What occasionally happens to the ceramic paper when it is heated?
c) What colour is lead(II) oxide?
d) Which reaction occurs most readily?
- 2 Predict which of the following pairs of metals and metal oxides react on heating. Write an equation for each reaction:
 - a) copper + zinc oxide
 - b) lead + copper(II) oxide
 - c) sodium + potassium oxide
 - d) calcium + magnesium oxide
 - e) aluminium + iron(III) oxide
 - f) zinc + lead(II) oxide
 - g) gold + copper(II) oxide
 - h) potassium + sodium oxide
 - i) magnesium + copper(II) oxide
 - j) iron + lead(II) oxide.

Do not attempt these as experiments.